CLAIMS

1. A device for stabilizing or controlling the lowering or raising of a structure (1, 32) between the surface (15) and the bed (7) of the sea, said device being characterized in that it includes at least one connection element (12) of the cable or chain type, having:

· a first end that is connected to a winch ($12_1$) on board a floating support or surface ship (20a, 20b), and on which winch it is wound; and

· a second end that is connected to a fastener element (10, 36) on said structure (1, 32), or on at least a first buoyancy element (19) that is connected to said structure; and

· the length of said connection element (12) is such that said winch ($12_1$) is capable of winding or unwinding said first end of said connection element (12), so that a bottom portion (13) of said connection element (12) can hang beneath said fastener element (10, 36).

2. A device according to claim 1, characterized in that it includes at least two of said connection elements (12), said fastener elements (10, 36) preferably being disposed symmetrically, respectively around and on the periphery of said structure (1, 32).

3. A device according to claim 1 or claim 2, characterized in that said connection element (12) is constituted by a cable having a bottom portion (13) that comprises weighting blocks (31) disposed in a string on a said cable, said weighting blocks preferably being metal blocks secured to said cable by clamping.

4. A device according to claim 3, characterized in that said blocks (31) present a shape such that when said bottom portion (13) hanging beneath said fastener elements curves, two of said blocks (31) disposed side by

side are capable of coming into abutment against each other, thereby limiting the curvature of said cable.

5. A device according to claim 4, characterized in that the curvature of said cable is limited so that the minimum radius of curvature ($R_0$) of said cables at said bottom portion (13) enables a minimum distance ($2R_0$) to be maintained between said cable (12) and said structure (1, 32) that is sufficient to prevent any mechanical contact between them while said structure is being lowered or raised.

6. A device according to any one of claims 3 to 5, characterized in that each of said blocks (31) present a cylindrical central portion (31) between two frustoconical ends ($31_2$) having axes that correspond to the direction of said cable (12) when said cable is disposed linearly, two adjacent blocks being in contact at said frustoconical ends along a generator line ($31_2$) of said frustoconical ends in the curved parts of said bottom portion (13).

7. A device according to claim 1 or claim 2, characterized in that said connection element comprises a chain having a bottom portion (13) that comprises links that are heavier than the links of the rest of the chain, and that are preferably larger so as to limit any curvature of the chain.

8. A device according to any one of claims 1 to 7, characterized in that said first buoyancy elements (19) are disposed above said structure.

9. A device according to any one of claims 1 to 8, characterized in that said structure includes second buoyancy elements (4, 33), preferably integrated in the top of said structure (1, 32), and more preferably

integrated above said fastener element(s) (10, 36) so that the center of gravity of said structure together with said first buoyancy elements is situated below the center of thrust that is exerted both on said structure (1) and on said first buoyancy elements (19).

10. A method of lowering, raising, or stabilizing a structure (1, 32) between the surface (15) and the bed (7) of the sea by means of a device according to any one of claims 1 to 9, said method being characterized in that it comprises the following steps: unwinding or winding each connection element at its first end by means of a said winch ($12_1$); and controlling the speed at which each connection element is lowered or raised by regulating the speed at which each connection element (12) is respectively wound off or on said winch ($12_1$), so as to adjust the length of said bottom portion (13) of said connection element (12) hanging beneath said fastener element (10, 36), the lowering, raising, or stabilizing of said structure being obtained when the sum of the weight of the fraction of said bottom portion(s) (13) of the connection element(s) (12) between firstly said fastener point(s) for fastening to said fastener element(s) (10, 36) and secondly the lowest point of said bottom portion(s) (13), plus the weight of said structure (1, 32) as a whole and of said first buoyancy element(s) (19), is respectively greater than, less than, or equal to the buoyancy thrust that is exerted on said structure (1, 32) and on said first buoyancy element(s) (19).

11. A method according to claim 10, characterized in that said structure is a rigid structure of steel, other metal, or composite synthetic material containing at least one and preferably a plurality of buoyancy compartments (4) that are suitable for being filled with a fluid that is lighter than water, and each being fitted with at least one filling orifice ($4_1$) and preferably with at least one

emptying orifice ($4_5$), said compartments (4) preferably being distributed symmetrically in said structure.

12. A method according to claim 10 or claim 11, characterized in that said structure is a massive structure constituted by an open-based receptacle (1) in the form of a cap, the receptacle comprising a peripheral side wall (2, 2a, 2b, $2_1$) surmounted by a roof wall (3, 3a, 3b) and being suitable for completely covering a wreck (6) of a ship on the sea bed (7) in order to recover polluting effluent (8) escaping therefrom, said receptacle having at least one emptying orifice (9) for discharging said effluent contained in the inside volume of said receptacle; said emptying orifice (9) preferably being situated in the roof (3, 3a, 3b) of the receptacle.

13. A method according to claim 11 or claim 12, characterized in that said receptacle is constituted as an upside-down double-walled ship hull comprising a rigid structure of steel, other metal, or composite synthetic material, said leaktight compartments (4) being defined by spaces between said double walls and by structural elements ($4_3$, $4_6$) interconnecting the double walls (2, 2a, 2b, $2_1$, 3, 3a, 3b).

14. A method according to claim 12 or claim 13, characterized in that the rigid structure of the walls (2, 2a, 2b, 3, 3a, 3b) constituting said receptacle is constituted by steel or metal beams (24) assembled to one another and having leaktight compartments (4) incorporated between them, said structure being covered on at least one face, preferably the outer face, by leakproof diaphragms or webs (21) fixed to said rigid structure in leaktight manner, said leaktight compartments being constituted by a self-contained closed casing incorporated inside said structure and secured thereto.

15. A method according to claim 11 or claim 12, characterized in that the rigid structure of the walls (2, 2a, 2b, $2_1$, 3, 3a, 3b) of the receptacle is made of concrete (26), preferably concrete lightened by clay beads, within which concrete hollow volumes are provided for defining said leaktight compartments (4).

16. A method according to any one of claims 11 to 15, characterized in that said receptacle (1) presents a vertical and longitudinal axial plane of symmetry XOZ, and comprises:

· a roof wall (3, 3a, 3b) comprising two longitudinally extending side walls (3a, 3b) that are inclined relative to said vertical axial plane of symmetry of said receptacle so as to form an upside-down V-shape in cross-section YOZ; and

· a side wall (2) comprising:

· two longitudinally extending side walls (2a, 2b) that are vertical or inclined relative to said vertical axial plane of symmetry (XOZ), each being contiguous with one of said longitudinally extending roof walls (3a, 3b); and

· two transverse end walls ($2_1$) that are vertical or inclined, preferably symmetrically about a vertical transverse plane of symmetry (YOZ).

17. A method according to any one of claims 11 to 16, characterized in that said receptacle (1) has posts (40, 41), at least some of which are preferably retractable (41), said posts being suitable for supporting said receptacle in quasi-isostatic manner when it is standing on the sea bed via said posts, the posts being deployed where necessary, and with the open base of said receptacle preferably being in a substantially horizontal position.

18. A method according to any one of claims 10 to 17, characterized in that said structure is fitted on the outside:

· with fastener elements (10, 10a-10b, $14_1$) enabling cables (12, 14) or chains (13) to be secured thereto for lowering said structure from the surface (15), and for putting it into place, and, where appropriate, anchoring it ($15_1$, $15_2$) to the sea bed (7); and

· preferably with thrusters (16), more preferably steerable thrusters enabling said structure to be moved in a horizontal direction in order to be positioned over said wreck (6).

19. A method according to any one of claims 10 to 18, characterized in that it comprises the following steps:

1) filling said leaktight compartments (4) completely or partially with a fluid, preferably a fluid that is lighter than sea water, with the extent to which said leaktight compartments (4) are filled being adjusted so as to cause said structure (1) to occupy an equilibrium position when immersed close to the surface;

2) lowering said structure (1) to the desired position by means of a device according to any one of claims 1 to 9 for controlling lowering, so as to regulate the speed at which the receptacle is lowered, and so as to provide equilibrium to the open base of said substantially horizontal structure while it is being lowered; and

3) once said structure (1) is in place at the desired depth, emptying said leaktight compartments (4) filled with fluid lighter than sea water, and simultaneously filling said leaktight compartments with sea water.

20. A method according to claim 19, characterized in that

· in step 1), additional buoyancy is provided to said structure by means of said first buoyancy elements

(19) consisting of additional floats (19) connected to said receptacle; and

· in step 3), once said structure is in the desired position, said additional floats (19) are detached.

21. A method according to claim 19 or claim 20, characterized in that after step 1) and before step 2), once said structure (1) has reached the desired position, the lengths of said heavy cables (or chains) (12) hanging beneath said fastening elements (10, 10a, 10b) and supported by said structure are reduced so as to stabilize said structure (1) in suspension, and

· where appropriate, said structure (1) is anchored (14, $15_1$-$15_2$) to the sea bed (7), and then

· said heavy cables (or chains) (12) are fully lowered so that their entire weight contributes to stabilizing said structure.

22. A method according to any one of claims 19 to 21, characterized in that said structure is a said receptacle and includes posts (40, 41), at least some of which are preferably retractable (41), and said retractable posts (41), if any, are deployed, in such a manner that said receptacle (1) rests on the sea bed on each of said posts in quasi-isostatic manner, and preferably with the open base of said receptacle in a substantially horizontal position.

23. A method according to any one of claims 19 to 22, characterized in that the receptacle (1) is positioned on the axis above the wreck (6) by actuating thrusters (16) mounted outside the receptacle (1) and preferably distributed symmetrically about its periphery.

24. A method according to any one of claims 19 to 23, characterized in that the fluid lighter than sea water filling said leaktight compartment (4) is gas oil, oil,

fresh water, or a liquefied gas that is lighter than sea water such as propane, butane, or ammonia.

25. A method according to claim 24, characterized in that

· in step 1), said leaktight compartments (4) are filled with a first fluid that is lighter than sea water; and

· in step 2), said structure (1) is lowered to a depth of 30 m to 60 m corresponding to a pressure of 3 bars to 6 bars, at which depth a liquefied gas that is lighter than sea water is injected under pressure into said leaktight compartments (4) from a gas tanker ship (31) on the surface.

26. A method according to any one of claims 19 to 25, characterized in that said structure is a said receptacle, and a fraction of the inside volume of said receptacle (1) defined on top by the roof (3, 3a, 3b) of said receptacle (1) and at the bottom by a diaphragm or web (21) tensioned between said side walls (2, 2a, 2b, $2_1$) of said receptacle is filled with a fluid that is lighter than sea water, preferably with fresh water, so as to create additional buoyancy while the receptacle is being towed at the surface and/or while the receptacle is being lowered to the sea bed; and

· once said receptacle is close to the sea bed (7), said diaphragm or web (21) is removed and said receptacle is placed on the sea bed (7) over the wreck (6), preferably via said posts (40, 41), after they have been deployed, where appropriate, and said fluid that is lighter than sea water is removed from the inside of said receptacle via said top emptying orifice (9) while said receptacle is close to the sea bed (7).

27. A method of recovering polluting effluent that is lighter than sea water, as contained in the tanks of a shipwreck (6) lying on the sea bed (7), in which method:

1) a said receptacle is put into place in accordance with the method of any one of claims 19 to 26; and

2) the effluent recovered inside said receptacle (1) is collected by being emptied out through said top emptying orifice (9).

28. A method according to claim 27, characterized in that in step 2) it comprises the following steps:

· lowering an empty said shuttle tank;

· positioning said shuttle tank (32) over said receptacle (1) in such a manner that its open bottom orifice is just above said emptying orifice (9) of said receptacle;

· preferably securing said shuttle tank (32) to said receptacle (1);

· emptying the effluent (8) contained in said shuttle tank; and

· once full, detaching said tank (32) from said receptacle (1), and raising said tank full of effluent to the surface.